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(54) **Fastener inserts**

(57) An insert for installation in plastics material has two sets of axially spaced oppositely handed splines, which embed in the material as a result of heating or ultrasonic vibrations applied to the inserts. To prevent fatigue cracking in the plastics from corners, the invention provides that all of the corners on the insert are rounded. Figure 1 shows the rounding or radiussing in elevation and Figure 3 shows the same in end elevation.

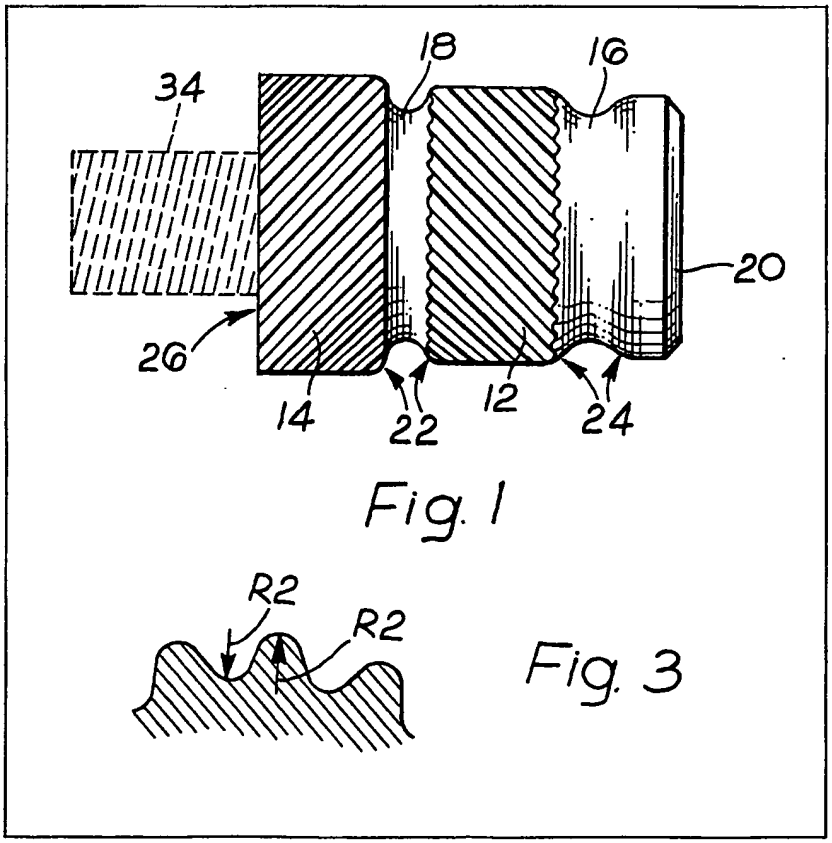

Fig. 1

Fig. 3

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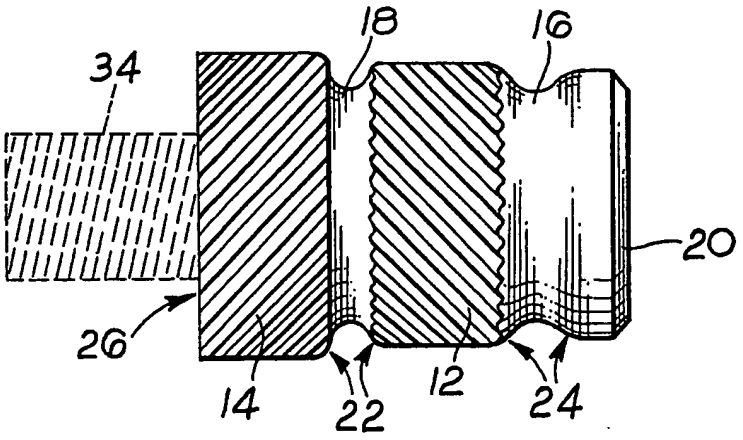

Fig. 1

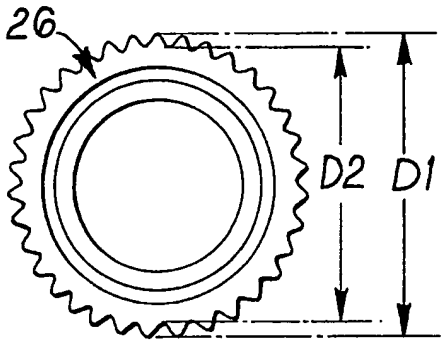

Fig. 2

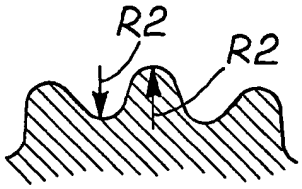

Fig. 3

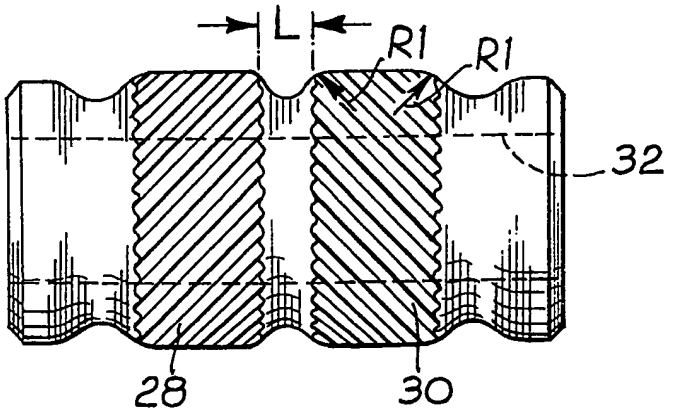

Fig. 4

SPECIFICATION

Improvements relating to fasteners

This invention relates to fasteners of the kind known as inserts, which are most usually intended for the purpose of providing a screw thread in (or on) a relatively soft material. It is well known to make an insert of brass or steel for example, with a female screw thread, and with external splines or teeth, and then press the insert into a preformed pilot bore in a plastics component. The teeth cut complementary grooves in the plastics, and the insert may be used to anchor a component against torque loads. By making the teeth helical, or otherwise non-axial although having an axial component, the insert can be inserted with a part rotary motion and will resist some axial load as well as angularly applied loads which tend to "screw" the insert in (but not loads which tend to "screw" the insert out).

It is also known, for example from BP 1279452 to provide two sets of splines or teeth of opposite hand i.e. clockwise and anticlockwise directed helices and press the insert into the plastics with high frequency vibrations (so called ultrasonics) or by direct heating which cause the plastics to flow locally so as to make room for the teeth and fill the intertooth spaces. The oppositely directed teeth allow such an insert to resist "screw out" loads in both directions of applied torque as well as providing better resistance to axial loads.

In all of these fasteners, it has been considered desirable to make the teeth as sharp as possible: that is to say to provide the teeth with flanks which meet at sharply defined apices with no radiussing, and in the case of the fastener of the said patent to make a square cut groove between the two sets of teeth. Logically the sharpness assists in penetration into the material even with the high frequency installation method.

The invention is based on the surprising discovery that with certain plastics materials greater efficiency particularly in terms of serviceable life of the plastics component is achieved by abandoning sharpness in favour of roundness, that is to say radiussed corners on all parts of the insert which are to contact the plastics material when inserted, including the teeth.

In accordance with the invention, an insert for installation in plastics material by direct heating or high frequency vibrations comprising a body having a plain pilot portion, a pair of portions spaced axially along the body having external teeth or splines, the teeth or splines being inclined in opposite directions, and the body being provided with a screw threaded portion, is characterised in that the external surfaces of the body including the teeth, which when the insert is installed are to contact the plastics material, are all radiussed and lack sharp apices.

Preferably, the relationship between the important dimensions of the fastener of the invention is defined by the following formula:-

$$L \geq 2R1 < (D1 - D2/2) > 2R2$$

where:- L is the axial length of the inter-toothed portion space; R1 is the radius of curvature at axial ends of the toothed portions; R2 is the radius of curvature of the crests and roots of the teeth; D1 is the crest diameter of a toothed portion; and D2 is the root diameter of the same toothed portion.

The materials with which the inserts of the invention are found to be superior are in the relatively hard plastics such as polycarbonates and those materials sold under the trade names NORYL and LEXAN for example.

When components are made of these materials and inserts are installed for the purpose of testing in the design of the components, it is found that the components sometimes fail due to cracking originating around the insert. The conventional explanation for this is that load is applied via the insert, or for example that the component is free to vibrate whilst the insert is fixed against vibration, so that in either case failure around the insert "is to be expected" and the component may be stiffened or otherwise supported in attempts to distribute the load. However, the invention is based on the realisation that the materials in question can be said to be notch sensitive, that is to say any structural failure in use tends to arise from cracking which may be analagous to fatigue cracking in metals, and such cracks are most likely to appear from internal sharp corners. The invention is based on the elimination of these such corners around the inserts. Whilst inserts of the kind described in the said prior patent 1279452 (with sharp corners) have been successfully installed in polycarbonates and have given satisfactory service therewith, the inserts of the present invention have been found experimentally to give improved service and enable greater loads to be applied to structures made of the notch sensitive materials without risk of cracks.

Apart from the essential features of pilot and splined or toothed portions, the inserts of the invention may vary in size, materials and shape, including the possibility of making the fasteners double-ended, that is to say symmetrical about a plane normal to the axis and halfway along the length, so that they can be hopper fed without any expensive and complicated mechanism to dispose them all in identical orientation: in this case the two splined portions will be of equal diameter. Alternatively the inserts may have a large diameter head opposite to the pilot end.

Embodiments of the invention are now described with reference to the accompanying drawings, wherein:-

Figure 1 is an elevation of an insert;

Figure 2 is a plan view;

Figure 3 is a fragmentary enlarged scale plan view; and

Figure 4 is an elevation of a modiciation.

Turning now to the drawings and particularly Figures 1 - 3, the insert comprises a body having a pilot portion 10, a first splined or toothed portion 12 and a second splined or toothed portion 14. Grooves 16 and 18 lie between the pilot and portion 12, and between the portions 12 and 14, respectively. Portions 12 and 14 are splined in opposite directions.

The pilot diameter is smaller than, or at most equal

to, the root diameter of the portion 12, and the crest diameter of the portion 12 is smaller than or at most equal to the root diameter of the portion 14. The pilot ends in a frusto-conical or bevelled portion 20.

In manufacture, the insert is made by turning bar stock, and knurling the portion 12 14. The two grooves can be formed by a round nosed tool so as to provide a single radius linking the adjacent faces of the portions 10 12 and 12 14 respectively. The corners 22 adjacent groove 18 and similarly the corners 24 adjacent groove 16 may have radii typically of the order of 0.004 inch (0.1 mm) although greater radii up to the maximum possible in order to offer a smooth transition from the groove radius to the notionally cylindrical face of the portions 10 12 14 are possible. The bevel 20 is not radiussed since this is not in contact with the plastics after the installation, as the insert is first place in a pilot bore of the same diameter as the pilot 10: similarly the perimeter of the end face 26 is not radiussed as this is flush with the plastics at the end of the installation step, and does not lead to any internal corners in the material.

The teeth may be radiussed uniformly at crest and root, for example so as to be continuously sinuous from each root over the flank to the crest and over the next flank to the next root, and may be of sinusoidal cross sectional shape. In a typical insert of about 0.3 inch diameter (to carry OBA or 6 mm internal screw thread therein) a radius of 0.006 inches at crest and root is possible, and in this example the helix angle may be 45° and the pitch interval may give 30 teeth per inch.

Figure 4 shows a double ended version particularly suitable for hopper feeding in automatic machines. In the case of Figure 4, the two portions 28 30 corresponding to the portions 12 and 14 in Figure 1 are of the same diameters as one another. The version of Figure 4 is suitable to provide a internally screwthreaded bore 32, whereas the version of Figure 1 may provide such a screwthreaded bore or may be provided with a male screwthreaded portion or stud 34 projecting from the face 26.

The drawings show the positions of the dimensions L. R1 and R2 and D1 and D2, as referred to earlier herein.

CLAIMS

1. An insert for installation in plastics material by direct heating or high frequency vibrations comprising a body having a plain pilot portion, a pair of portions spaced axially along the body having external teeth or splines, the teeth or splines being inclined in opposite directions, and the body being provided with a screwthreaded portion, characterised in that the external surface of the body including the teeth, which when the insert is installed are to contact the plastics material, are all radiussed and lack sharp apices.

2. An insert as claimed in Claim 1 wherein the relationship of the dimensions is defined by the formula:- $L \geq 2R1 < (D1 - D2\ 2) > 2R2$ where: L is the axial length of the intertoothed portion space; R1 is the radius of curvature at axial ends of the toothed portions; R2 is the radius of curvature of the crests and roots of the teeth; D1 is the crest diameter of a toothed portion; and D2 is the root diameter of the same toothed portion.

3. An insert as claimed in Claim 1 or Claim 2 wherein said pair of portions are of the same diameter and a plane pilot portion is provided at each end.

4. An insert substantially as described with reference to Figures 1 to 3 of the accompanying drawings.

5. An insert substantially as described with reference to Figure 4 of the accompanying drawings.

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